Rapid Fire Mini Symposium: A Brief Snapshot of Load Carriage TRU Research

Orr, Rob Marc

Welcome

Tactical Research Unit

Rapid Fire Mini Symposium


ENGAGE
INFLUENCE
IMPACT
RESEARCH
WEEK
14 - 18 OCTOBER
2019

A Brief Snapshot of Load Carriage TRU Research

Dr Rob Orr (Lead Tactical Research Unit)

Tactical Research Unit, Bond University

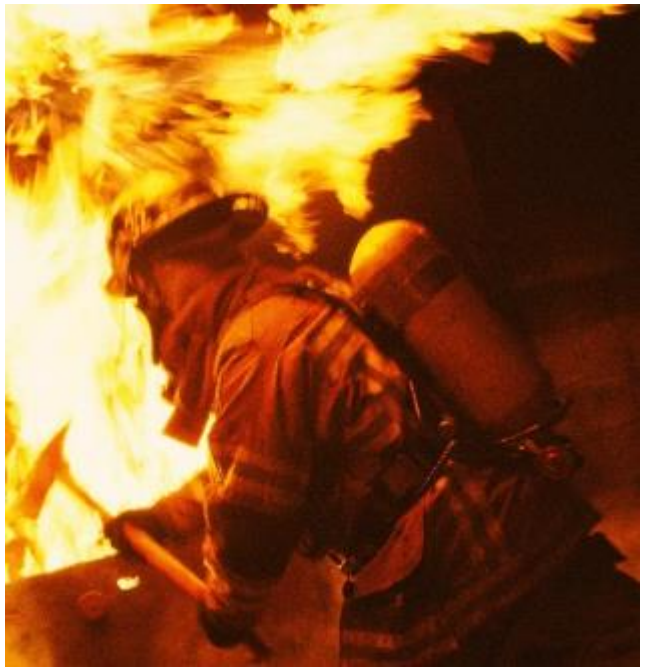
Load Carriage and Firefighters

* The loads have changed (Firefighters)

1770

1879

2012



http://www.stacksplace.com/EMS/ffadd1.jpg

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Load Carriage and Firefighters

* The loads have changed (Firefighters)

	Mean± SD
Loaded weight (kg)	21.39 ± 0.68 kg

Walker A, Pope R, Schram B, Gorey R, and Orr R. (2019). The Impact of Occupational Tasks on Firefighter Hydration During a Live Structural Fire. Safety 5: 36.

Load Carriage and Firefighters

- Decrements in performance:
  - ↓ Mobility *(Park et al., 2008:2010: Ruby et al., 2003)*

Australian Fire Season 2013 – Firestorm moved at speeds of up to 31-37 mi/h

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Load Carriage and Firefighters

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Load Carriage and Firefighters

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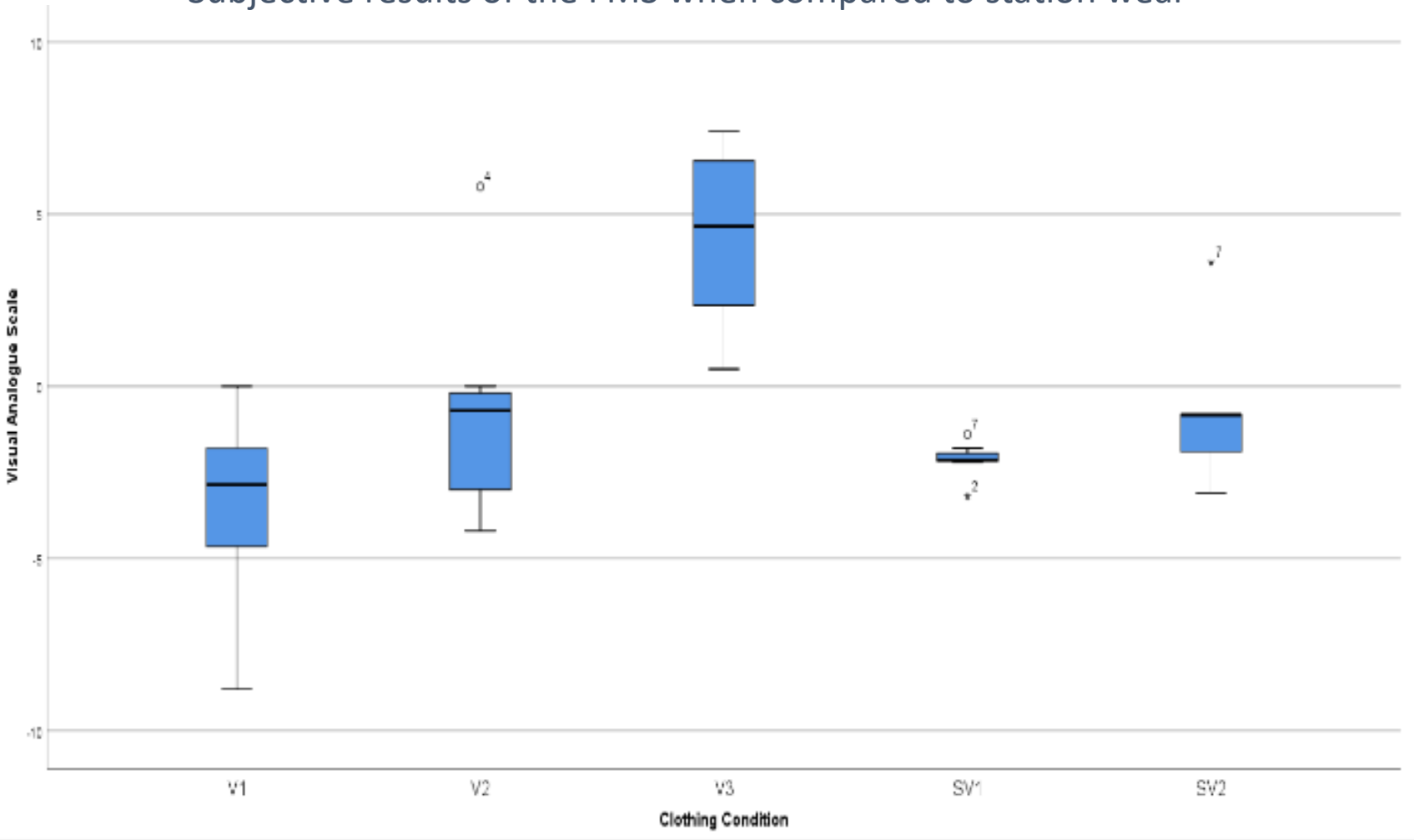
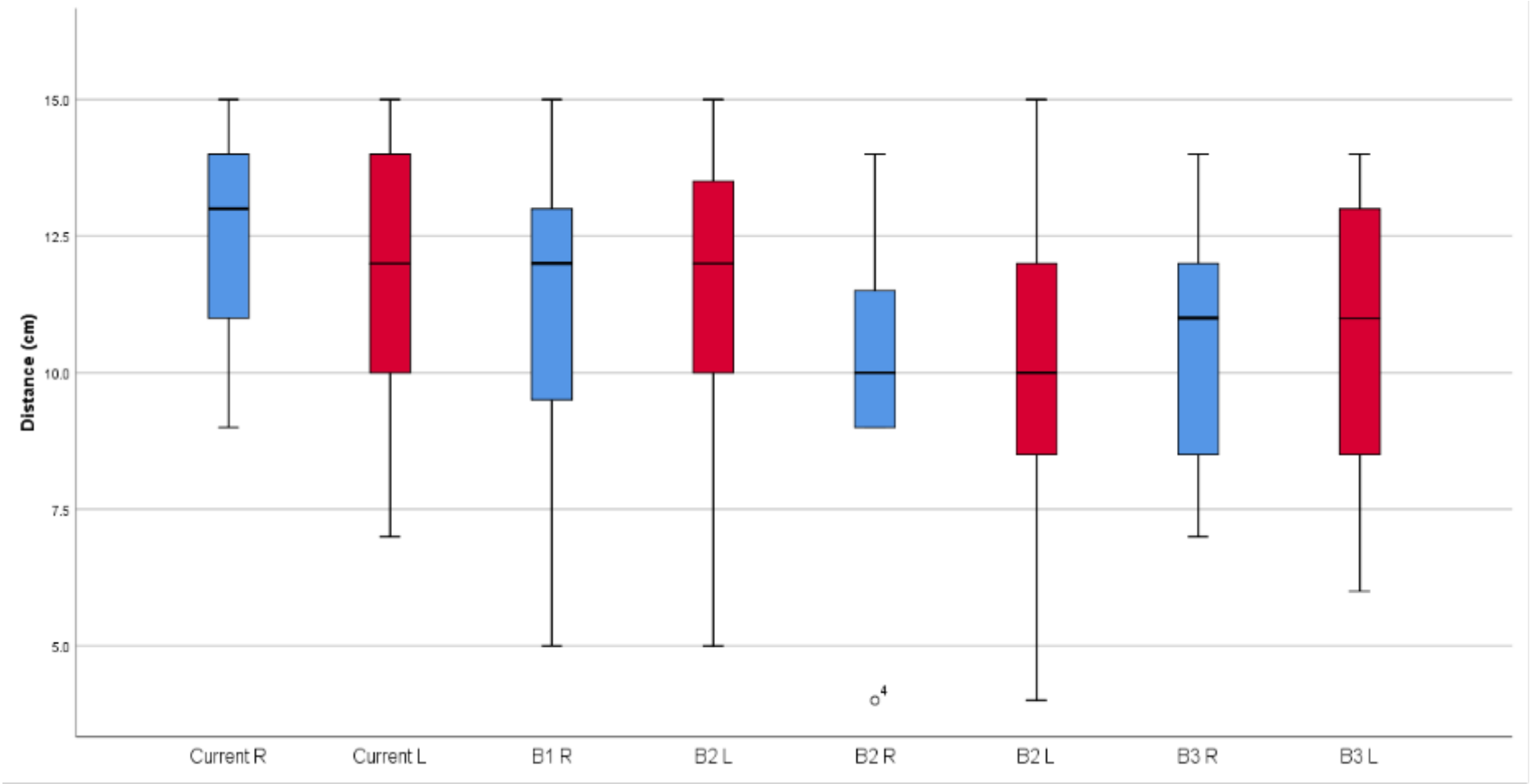
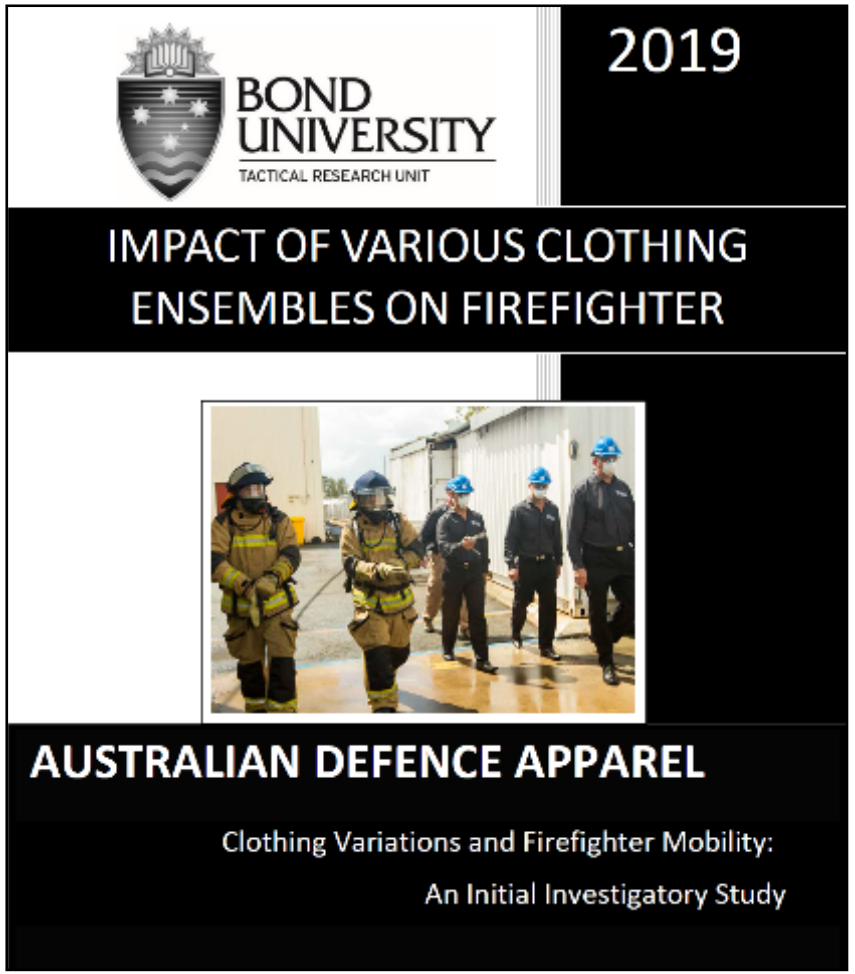
Subjective results of the FMS when compared to station wear




Distance (cm)
15.0
12.5
10.0
7.5
5.0
4
Current R
Current L
B1 R
B2 L
B2 R
B2 L
B3 R
B3 L



Review

A Profile of Injuries Sustained by Firefighters: A Critical Review

Robin Orr[1,2,*], Vinicius Simas [1,2], Elisa Canetti[1,2] and Ben Schram[1,2]

[1] Bond Institute of Health and Sport, Bond University, Gold Coast, QLD 4229, Australia
[2] Tactical Research Unit, Bond University, Gold Coast, QLD 4229, Australia
[*] Correspondence: rorr@bond.edu.au

Abstract: Firefighters, along with other tactical personnel, are at a high risk of work-related physical injury above that of the private sector. The aim of this critical narrative review was to identify, critically appraise and synthesize key findings from recent literature investigating firefighting musculoskeletal injuries to inform injury reduction programs. The methodological approach (search terms, databases, etc.) was registered with PROSPERO and reported following the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines. Study quality were assessed using the Downs and Black checklist with scores and graded according to the Kennelly grading system. Levels of evidence were ranked according to the Australian National Health and Medical Research Council. Of the 8231 studies identified, 17 met the criteria for inclusion. The methodological quality of the studies was 'fair' with a level of evidence of III-2. Reported injury rates ranged from 9-74% with the lower extremities and back the leading aggregated bodily sites of injury. Sprains and strains were the leading nature of musculoskeletal injury, often caused by slips, trips and falls, although muscle bending, lifting and squatting or muscle stressing were also prevalent. This review may inform injury reduction strategies and given that injuries reported in firefighters are similar to those of other tactical populations, safety processes to mitigate injuries may be of benefit across the tactical spectrum.

Keywords: fireman; firefighter; injury; tactical; occupational health

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Load Carriage and Law Enforcement

http://images.canberratimes.com.au/2012/06/24/3400673/art729-st24policewomen-420x0.jpg

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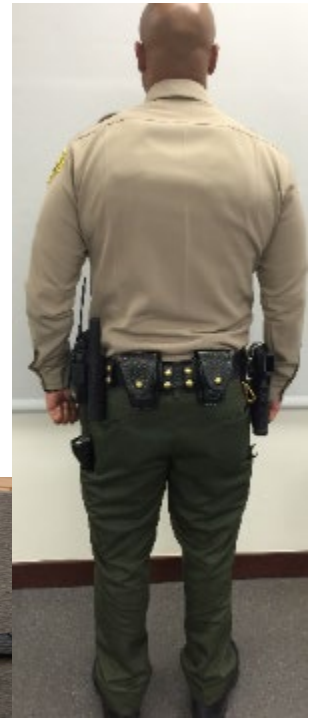
Load Carriage and Law Enforcement

	FEMALE (n=43)	MALE (n=203)
Age (yrs)	30.60±4.56	30.86±6.09
Body Wt (Kg)	68.78±10.96*	89.27±13.31
Load Wt (Kg)	9.99±1.66*	10.87±1.71
Relative load (%)	13.36±2.46*	11.50±2.24



Baran, K. Dulla, J., Orr, R., Dawes, J. & Pope, R. (2018). Duty loads carried by the LA Sheriff's Department Officers Journal of Australian Strength and Conditioning

Load Carriage and Law Enforcement

PTG Mean Load of 22kg

Excluding specialised equipment

Carbone P, Carlton S, Orr R, and Robinson J. (2013). The Impact of Load Carriage on Mobility and Marksmanship of the Tactical Response Officer. *Journal of Australian Strength and Conditioning*: 105-106

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Table 6. Functional movement screen (FMS) results (mean ± SD) by body armour type and FMS movement element, and overall.

	MBA	LEBA
Deep squat	2.20 ± 0.79	2.50 ± 0.71
Hurdle step	1.80 ± 0.63	1.80 ± 0.79
Inline lunge	2.10 ± 0.74	2.70 ± 0.48 *
Shoulder mobility	1.40 ± 0.52	1.90 ± 0.57 ‡
Active straight leg raise	1.80 ± 0.79	2.30 ± 0.67
Trunk stability pushup	2.30 ± 0.82	2.60 ± 0.52
Rotary stability	1.80 ± 0.79	1.60 ± 0.84
Total	13.40 ± 2.17	15.40 ± 1.90 *

* significantly greater than with MBA vest ($p < 0.05$); ‡ $p = 0.059$.

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Tomes et al. Annals of Occupational and Environmental Medicine (2017) 29:14
DOI 10.1186/s40557-017-0169-9

Annals of Occupational and Environmental Medicine

RESEARCH ARTICLE Open Access

The impact of body armor on physical performance of law enforcement personnel: a systematic review

Colin Tomes[1,2], Robin Marc Orr[2*] and Rodney Pope[2]

Abstract

Background: The law enforcement officer profession requires performance of arduous occupational tasks while carrying an external load, consisting of, at minimum, a chest rig, a communication system, weaponry, handcuffs, personal protective equipment and a torch. The aim of this systematic review of the literature was to identify and critically appraise the methodological quality of published studies that have investigated the impacts of body armour on task performance and to synthesize and report key findings from these studies to inform law enforcement organizations.

Methods: Several literature databases (Medline, CINAHL, SPORTDiscus, EMBAS) were searched using key search words and terms to identify appropriate studies. Studies meeting the inclusion criteria were critically evaluated using the Downs and Black protocol with inter-rater agreement determined by Cohen's Kappa.

Results: Sixteen articles were retained for evaluation with a mean Downs and Black score of 73.2 + 6.8% (k = 0.841). Based on the research quality and findings across the included studies, this review determined that while effects of body armour on marksmanship and physiological responses have not yet been adequately ascertained, body armour does have significant physical performance and biomechanical impacts on the wearer, including: a) increased ratings of perceived exertion and increased time to complete functional tasks, b) decreased work capability (indicated by deterioration in fitness test scores), c) decreased balance and stability, and d) increased ground reaction forces.

Conclusions: Given the physical performance and biomechanical impacts on the wearer, body armour should be carefully selected, with consideration of the physical fitness of the wearers and the degree to which the armour systems can be ergonomically optimized for the specific population in question.

Keywords: Officer, Police, Body armour, Personal protective equipment

International Journal of Environmental Research and Public Health

MDPI

Article

A Comparison of Military and Law Enforcement Body Armour

Robin Orr [1,*], Ben Schram [1] and Rodney Pope [1,2]

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2 School of Community Health, Charles Sturt University, Albury-Wodonga 2640, Australia
* Correspondence: rorr@bond.edu.au; Tel.: +617-5595-4448

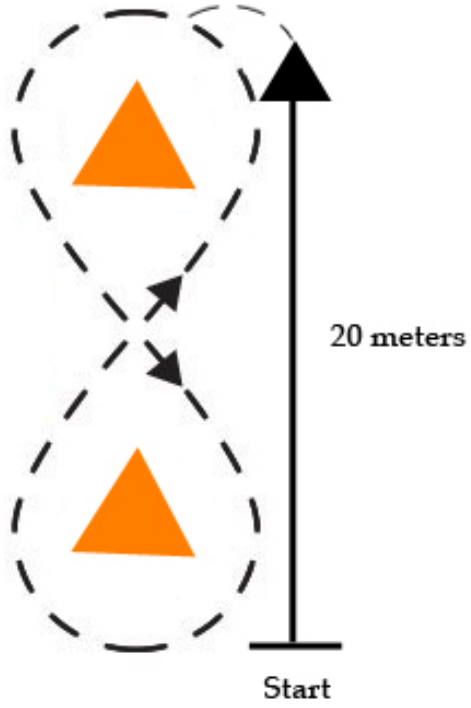
Received: 12 January 2018; Accepted: 9 February 2018; Published: 14 February 2018

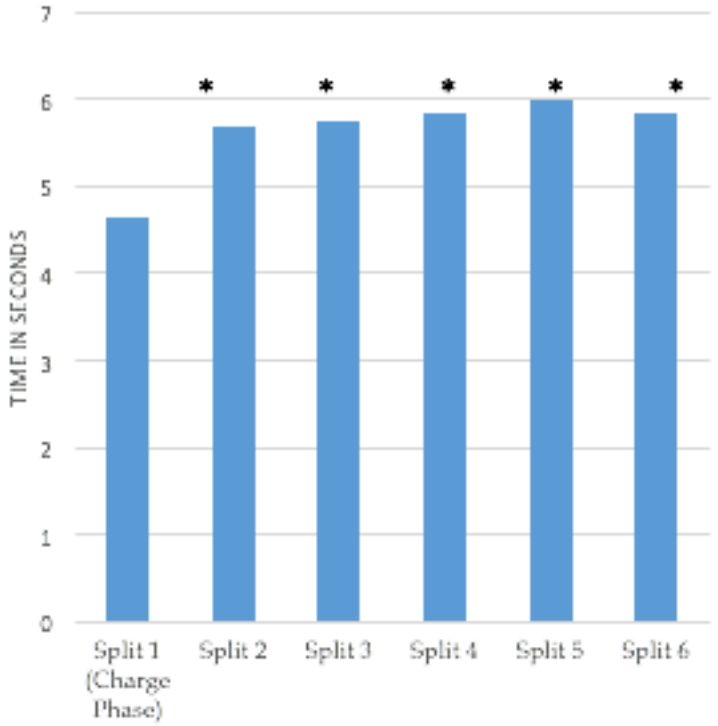
Abstract: Law-enforcement officers increasingly wear body armour for protection; wearing body armour is common practice in military populations. Law-enforcement and military occupational demands are vastly different and military-styled body armour may not be suitable for law-enforcement. This study investigated differences between selected military body armour (MBA: 6.4 kg) and law-enforcement body armour (LEBA: 2.1 kg) in impacts on postural sway, vertical jump, agility, a functional movement screen (FMS), task simulations (vehicle exit; victim recovery), and subjective measures. Ten volunteer police officers (six females, four males) were randomly allocated to one of the designs on each of two days. Body armour type did not significantly affect postural sway, vertical jump, vehicle exit and 5 m sprint times, or victim recovery times. Both armour types increased sway velocity and sway-path length in the final five seconds compared to the first 5 s of a balance task. The MBA was associated with significantly slower times to complete the agility task, poorer FMS total scores, and poorer subjective ratings of performance and comfort. The LEBA was perceived as more comfortable and received more positive performance ratings during the agility test and task simulations. The impacts of MBA and LEBA differed significantly and they should not be considered interchangeable.

Keywords: police; armor; occupational tasks; load; personal protective equipment; army; defense

Load Carriage and Law Enforcement

- Decrements in performance:
  - ↓ Mobility *(Joseph et al., 2018)*

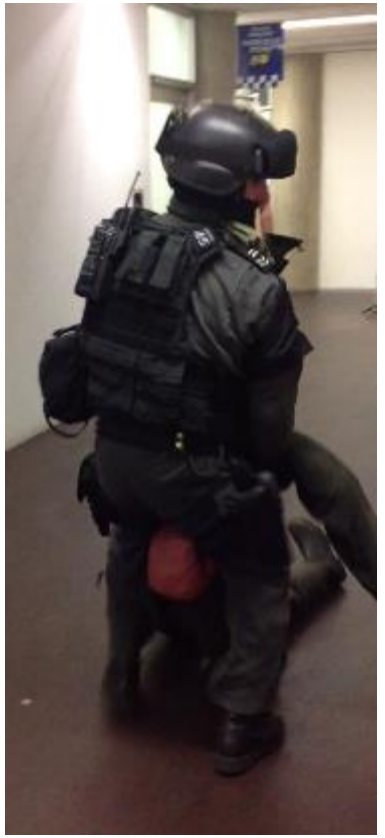




Load Carriage and Law Enforcement

- Decrements in performance:
  - ↓ Mobility *(Carlton et al., 2014)*

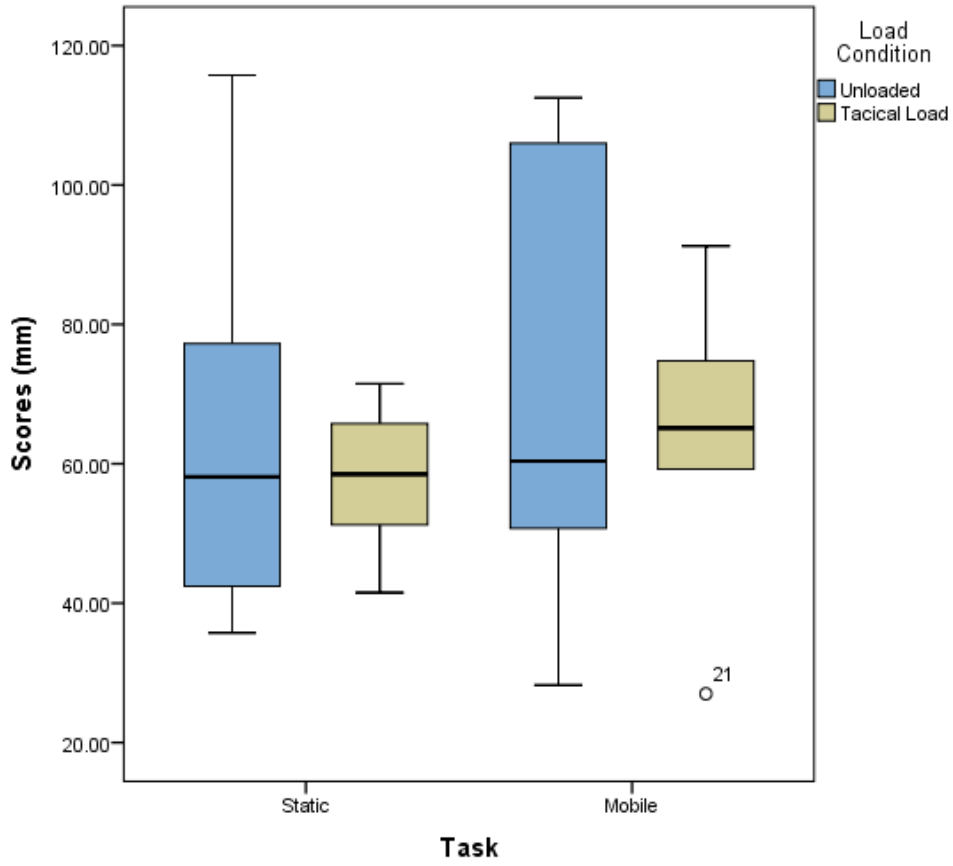
	Unloaded	Loaded
10m sprint (sec)	2.40 ± 0.22	2.46 ± 0.15
10m dummy drag (sec)	6.89 ± 0.44	7.79 ± 0.75*
Total time (sec)	9.29 ± 0.53	10.25 ± 0.77*



* Indicates statically significant differences between unloaded and loaded, $p<0.01$.

Load Carriage and Law Enforcement

- Decrements in performance:
  - ?Lethality *(Carbone et al, 2014)*



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Load Carriage and Law Enforcement

- Decrements in performance:
  - ?Lethality *(Orr, Poke, et al, 2018)*

Subject Number ST

How do you think tactical load impacts on your marksmanship with the pistol when compared to carrying no load:

-10 0 +10

Worse No Change Better

How do you think tactical load impacts on your marksmanship with the rifle when compared to carrying no load:

-10 0 +10

Worse No Change Better

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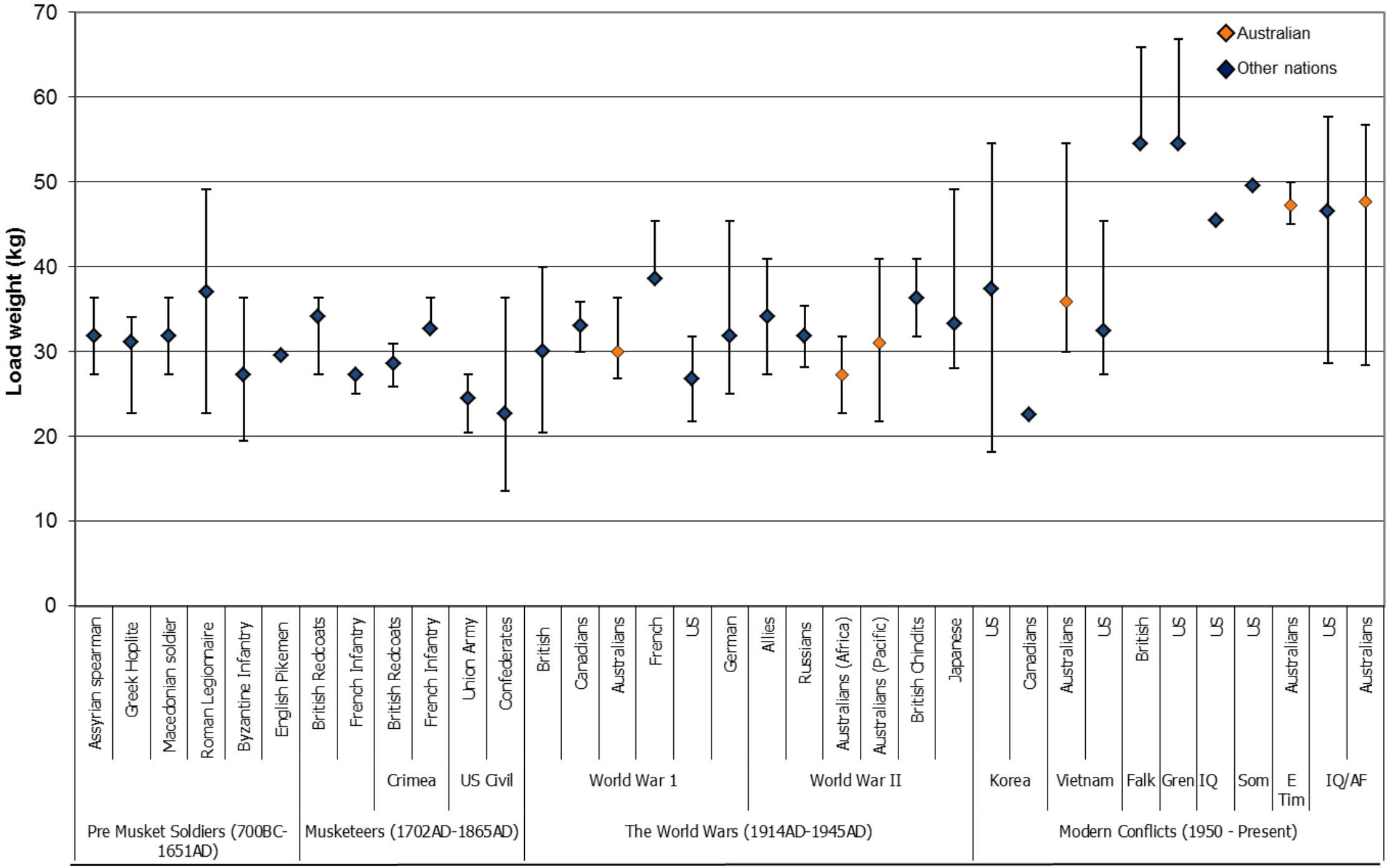
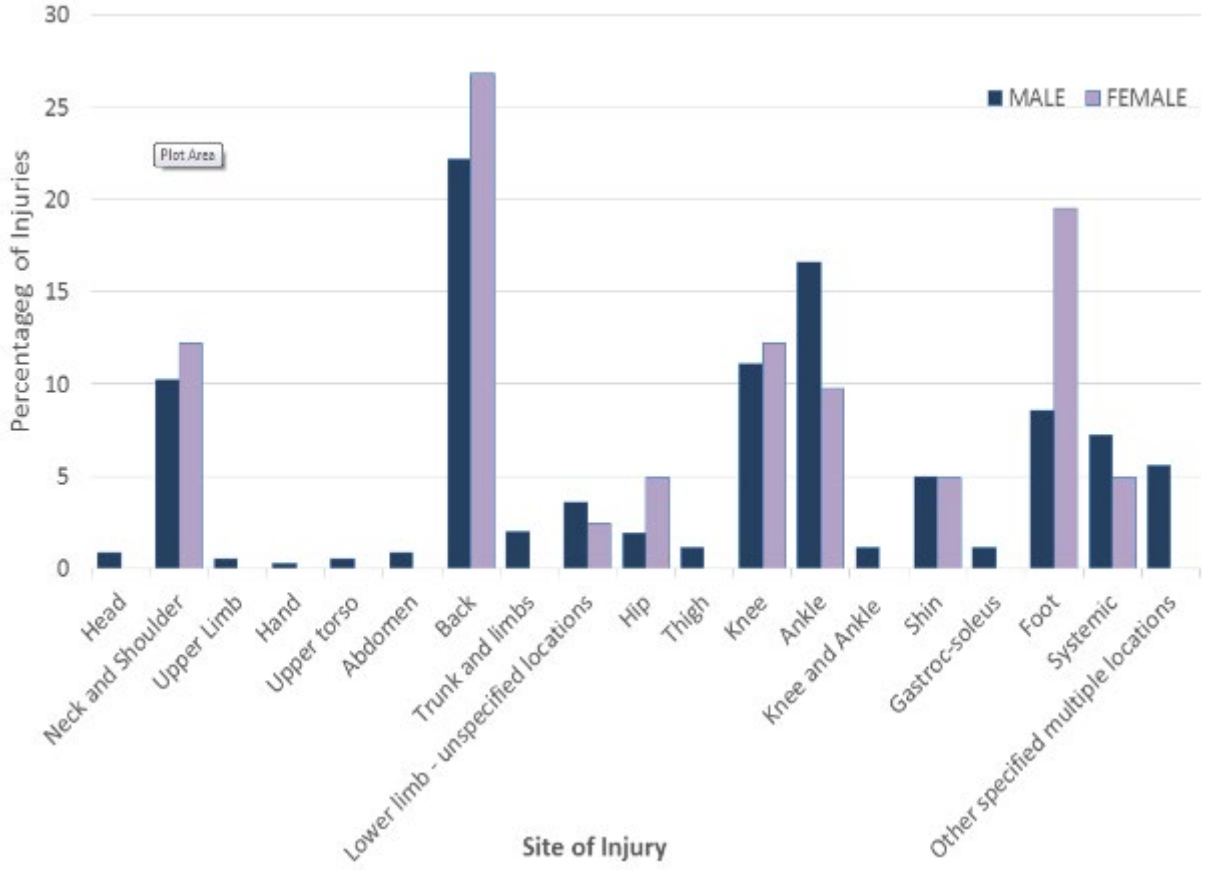
Load Carriage and the Military


Load weight (kg)
70
60
50
40
30
20
10
0
Australian
Other nations
Assyrian spearman
Greek Hoplite
Macedonian soldier
Roman Legionnaire
Byzantine Infantry
English Pikemen
British Redcoats
French Infantry
British Redcoats
French Infantry
Crimea
Union Army
Confederates
US Civil
British
Canadians
Australians
French
US
German
World War 1
Allies
Russians
Australians (Africa)
Australians (Pacific)
British Chindits
Japanese
World War II
US
Canadians
Korea
Australians
US
Vietnam
British
Falk
US
Gren
US
IQ
US
Som
Australians
E Tim
US
Australians
IQ/AF
Pre Musket Soldiers (700BC-1651AD)
Musketeers (1702AD-1865AD)
The World Wars (1914AD-1945AD)
Modern Conflicts (1950 - Present)

Load Carriage and the Military

- Load carriage specific injuries: By gender



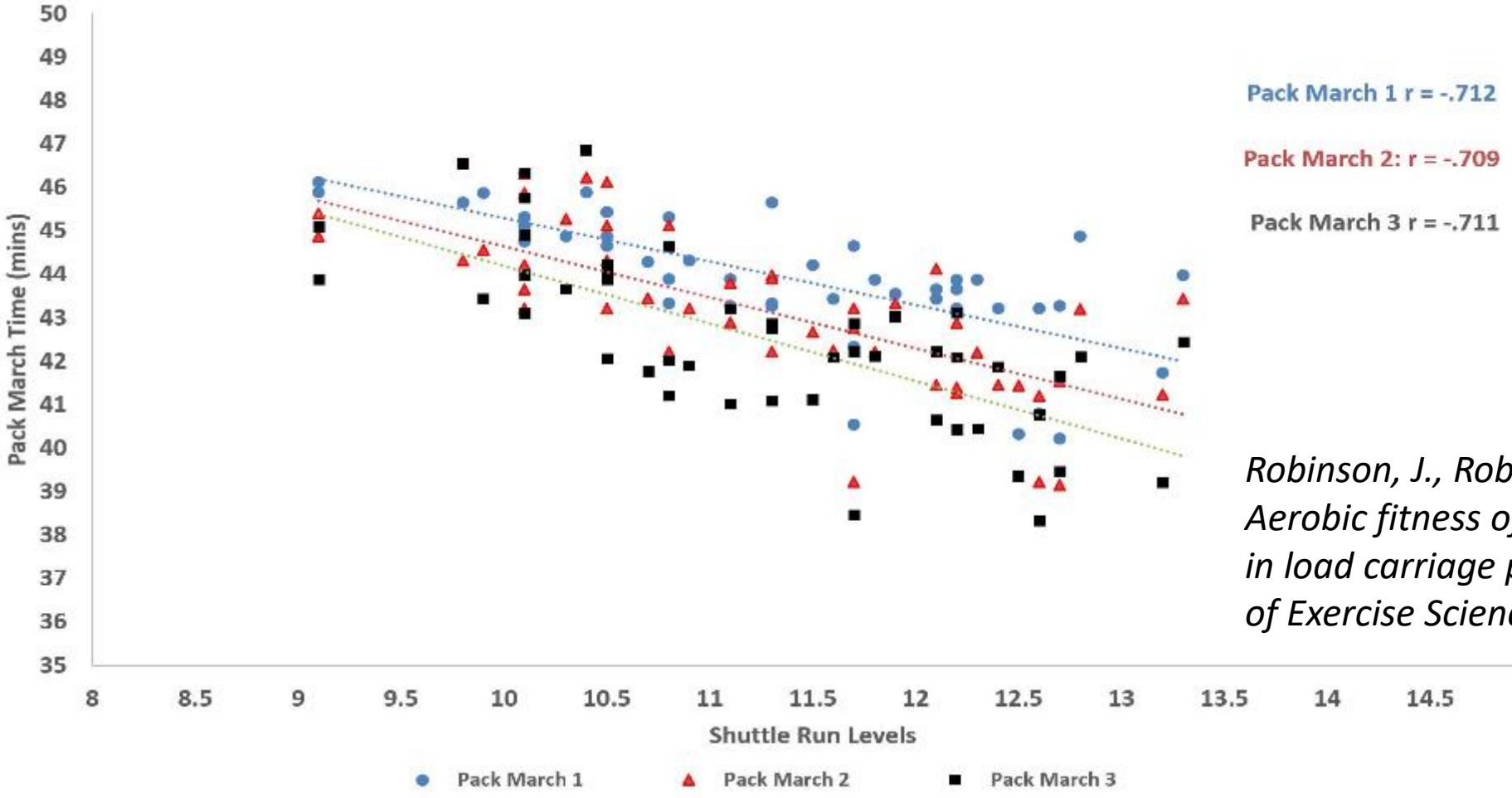
Orr, R. & Pope, R. (2016) Gender Differences in Load Carriage Injuries of Australian Army Soldiers, BMC Musculoskeletal Disorders, 17 (488), pp. 1-8. DOI 10.1186/s12891-016-1340-0

Load Carriage and the Military

- Potentially heavier relative loads with the removal of combat restrictions
- Similar risk of lower back injuries but may be more serious injuries
- Female athlete triad / Relative Energy Deficiency in Sport (RED-S)
- Pelvic floor challenges
- Optimising load carriage specific and general strength and conditioning is vital

Orr, R., Pope, R., O'Shea, S. & Knapik, J. (accepted). Load carriage and female military personnel, Strength and Conditioning Journal

Load Carriage – Conditioning requirements



Pack March 1 r = -.712

Pack March 2: r = -.709

Pack March 3 r = -.711

Robinson, J., Roberts, A. Irving, S. & Orr., R. (2018). Aerobic fitness of greater importance than strength in load carriage performance. International Journal of Exercise Science 11(4): 987-998

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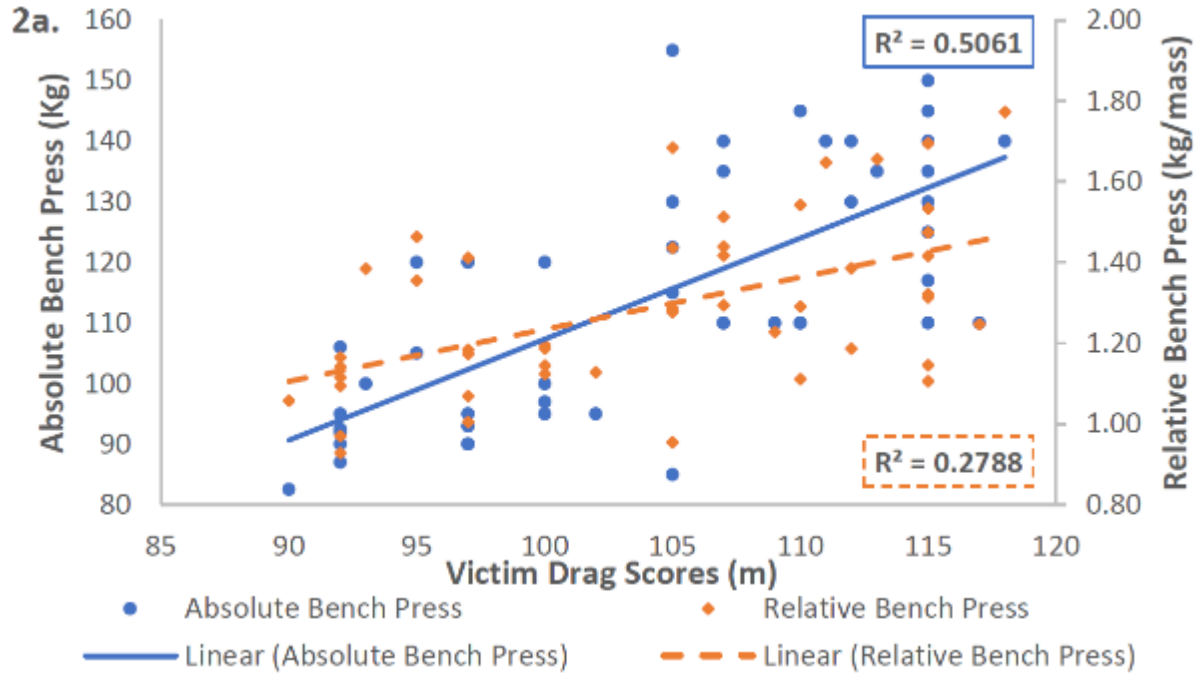
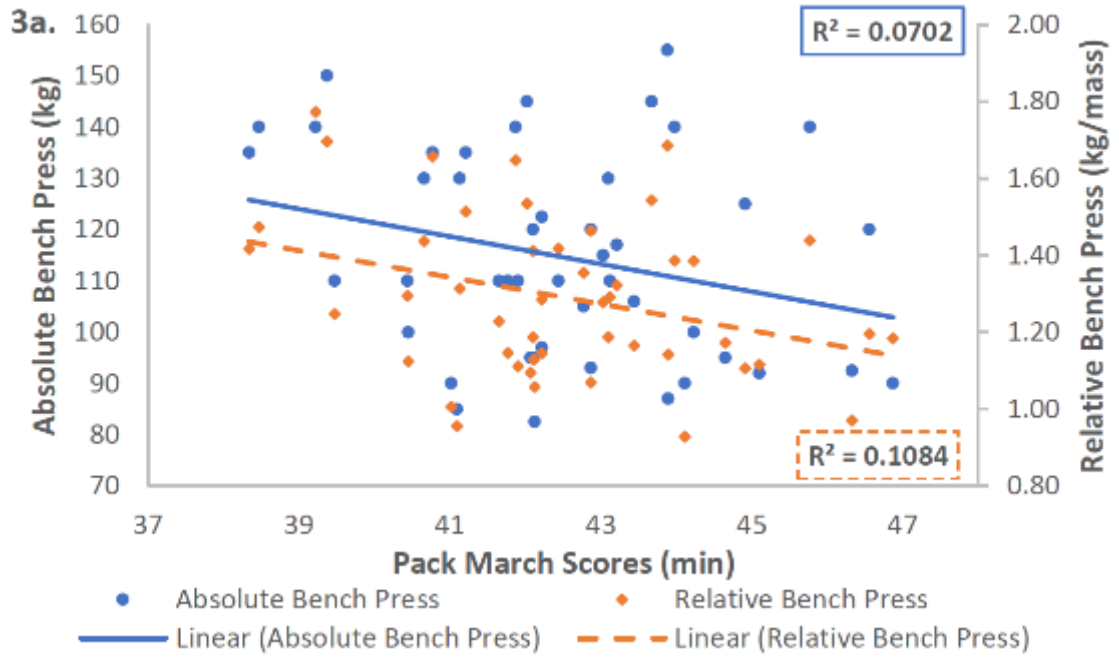
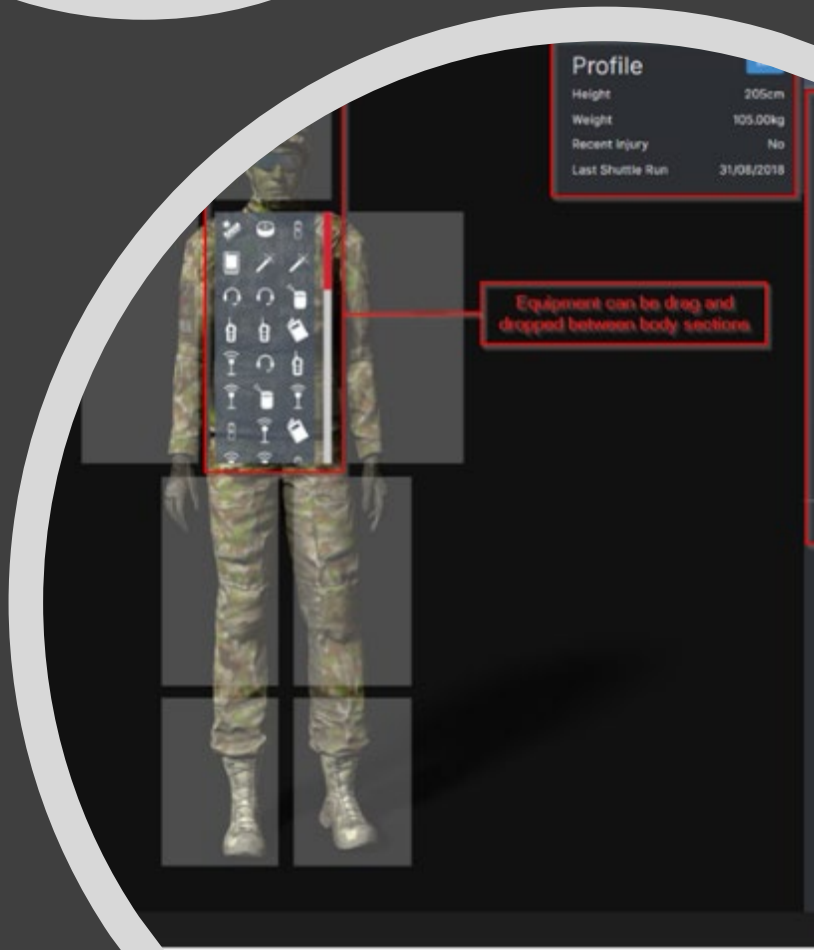
Load Carriage – Conditioning requirements





Orr., R., Robinson, J., Hasanki, K., Talaber, K., Schram, B. & Roberts, M. (post review) The Relationship between Strength Measures and Task Performance in Specialist Tactical Police. Journal of Strength and Conditioning Research



Current / Emerging Projects

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TITLE

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